Task 2.3

Table of Contents


```
addpath('../tapas/HGF')
clear all;
close all;

u = load('example_binary_input.txt');

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
```

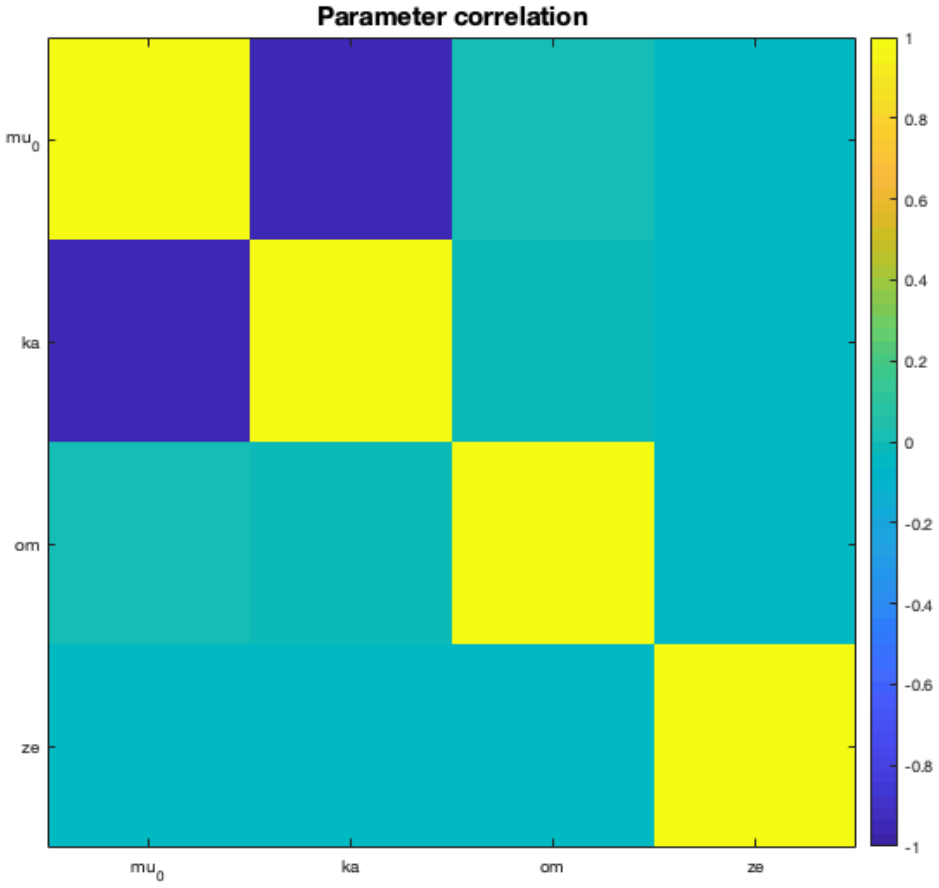
a)k2=2.5, w2=-4, w3=-6, mu3=1, sa3=1, ze =5

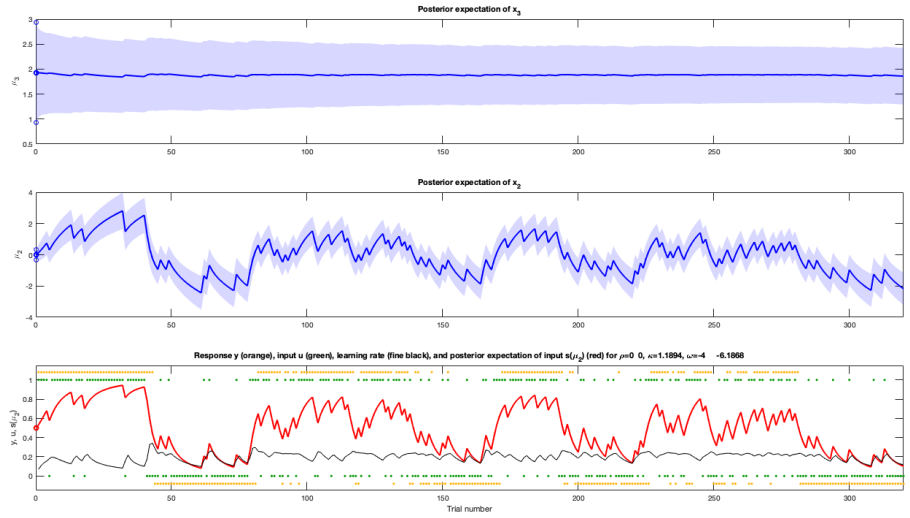
```
% The \omega_3 is very accurate in all our results.
% The estimated parameters are not as accurate as the set ones since
 the
% variance is not zero. For example the \kappa_2 is not accurate when
 we
% estimate it but nearly 2.5 when not estimating this parameter.

% The first covariance plot shows large correlation between \kappa_2
 and
% \mu_0.
% The second covariance plot shows large correlation between \omega_2
 and
% \mu_0.


%simulate model
sim = tapas_simModel(u,...
'tapas_hgf_binary',...
[NaN 0 1 NaN 1 1 NaN 0 0 1 2.5 NaN -4 -6],...
'tapas_unitsq_sgm',...
5);

%estimate param: (ze,mu3,K2,exp(w3))
est1 = tapas_fitModel(sim.y,...
                      sim.u,...
                      'tapas_hgf_binary_config_2',...
                      'tapas_unitsq_sgm_config',...
```

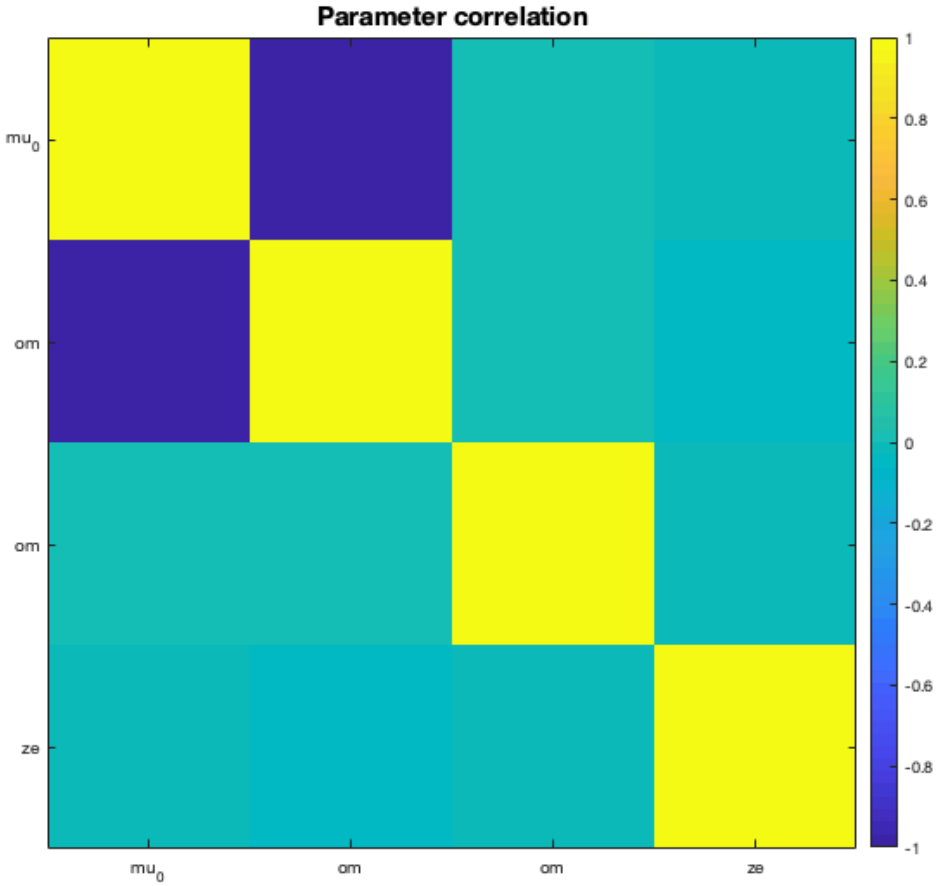
```
                    'tapas_quasinewton_optim_config')


%plot posterior correlation
tapas_fit_plotCorr(est1)

%plot trajectories
tapas_hgf_binary_plotTraj(est1)


%estimate param: (ze,mu3,w2,exp(w3))
est2 = tapas_fitModel(sim.y,...
                    sim.u,...
                    'tapas_hgf_binary_config_3',...
                    'tapas_unitsq_sgm_config',...
                    'tapas_quasinewton_optim_config')


%plot posterior correlation
tapas_fit_plotCorr(est2)

%plot trajectories
tapas_hgf_binary_plotTraj(est2)

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%

Ignored trials: none
Ignored trials: none
Irregular trials: none

Optimizing...

Calculating the log-model evidence (LME)...

Results:

Parameter estimates for the perceptual model:
    mu_0: [NaN 0 1.9273]
    sa_0: [NaN 0.1000 1]
     rho: [NaN 0 0]
      ka: [1 1.1894]
      om: [NaN -4 -6.1868]


Parameter estimates for the observation model:
    ze: 5.2025

Model quality:
    LME (more is better): -64.9974
    AIC (less is better): 123.5299
    BIC (less is better): 138.6032

    AIC and BIC are approximations to -2*LME = 129.9947.
```

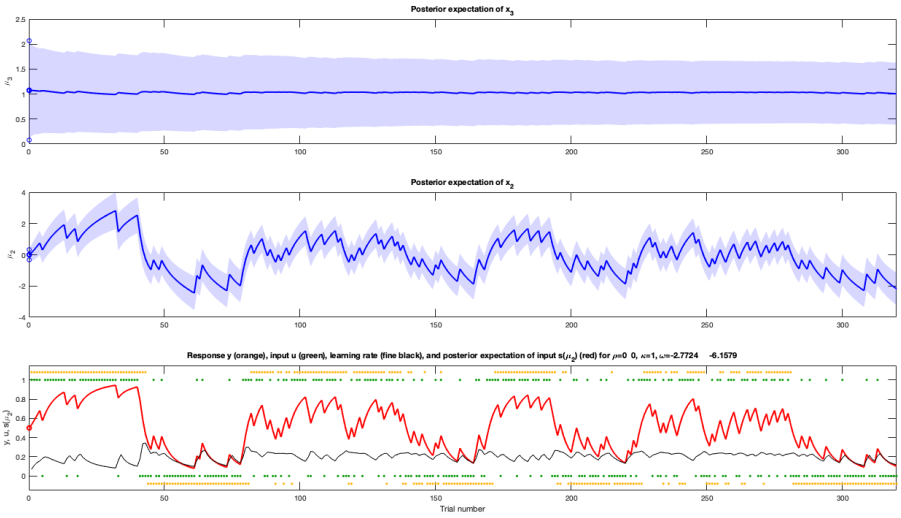
```
est1 =

  struct with fields:

        y: [320×1 double]
        u: [320×1 double]
      ign: []
      irr: [0×1 double]
    c_prc: [1×1 struct]
    c_obs: [1×1 struct]
    c_opt: [1×1 struct]
    optim: [1×1 struct]
    p_prc: [1×1 struct]
    p_obs: [1×1 struct]
     traj: [1×1 struct]

Ignored trials: none
Irregular trials: none

Optimizing...

Calculating the log-model evidence (LME)...

Results:

Parameter estimates for the perceptual model:
    mu_0: [NaN 0 1.0745]
    sa_0: [NaN 0.1000 1]
     rho: [NaN 0 0]
      ka: [1 1]
      om: [NaN -2.7724 -6.1579]


Parameter estimates for the observation model:
    ze: 5.1820

Model quality:
    LME (more is better): -65.4753
    AIC (less is better): 123.497
    BIC (less is better): 138.5703

    AIC and BIC are approximations to -2*LME = 130.9506.


est2 =

  struct with fields:

        y: [320×1 double]
        u: [320×1 double]
      ign: []
      irr: [0×1 double]
```

```
c_prc: [1×1 struct]
c_obs: [1×1 struct]
c_opt: [1×1 struct]
optim: [1×1 struct]
p_prc: [1×1 struct]
p_obs: [1×1 struct]
 traj: [1×1 struct]
```




Posterior expectation of x3
Posterior expectation of x2
Response y (orange), input u (green), learning rate (fine black), and posterior expectation of input s(μ1) (red) for ϑ=0 0, κ=1.1894, ω=-4 -6.1868
Trial number


Parameter correlation
mu0
om
om
ze
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1



b)k2=1, w2=-4, w3=-4.1674, mu3=2.5, sa3=6.25, ze = 5

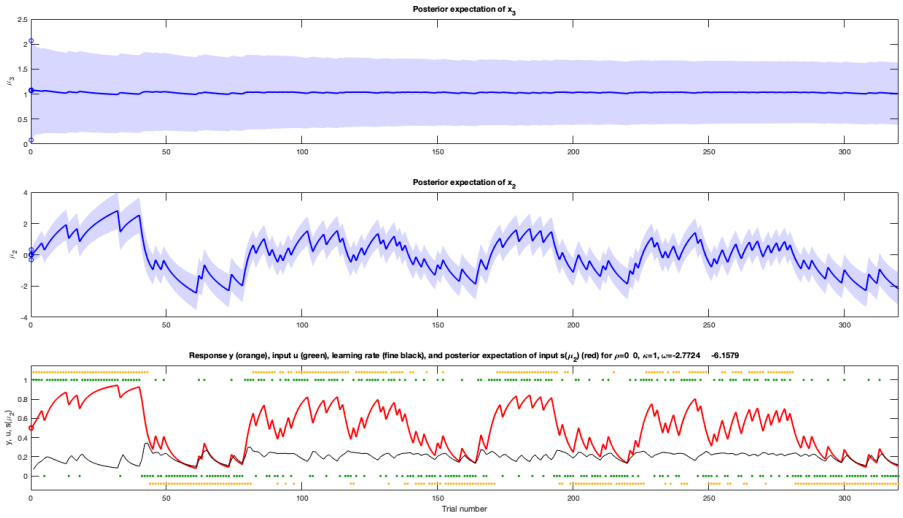
```
% The \omega_3 is very accurate in all our results.
% The estimated parameters are not as accurate as the set ones since
 the
% variance is not zero. For example the \kappa_2 is not accurate when
 we
% estimate it but equal to 1 when not estimating it.

% The estimates for \zeta and \theta are more accurate in b) than in
 a).
% We think a possible explanation for the better estimates is that the
% volatility coeffitient \theta is higher and therefore the model is
 more
% flexible

% The first covariance plot shows large correlation between \kappa_2
 and
% \mu_0.
% The second covariance plot shows large correlation between \omega_2
 and
% \mu_0.

%simulate model
sim2 = tapas_simModel(u,...
'tapas_hgf_binary',...
[NaN 0 2.5 NaN 1 6.25 NaN 0 0 1 1 NaN -4 -4.1674],...
'tapas_unitsq_sgm',...
5);

%estimate model
est3 = tapas_fitModel(sim2.y,...
```

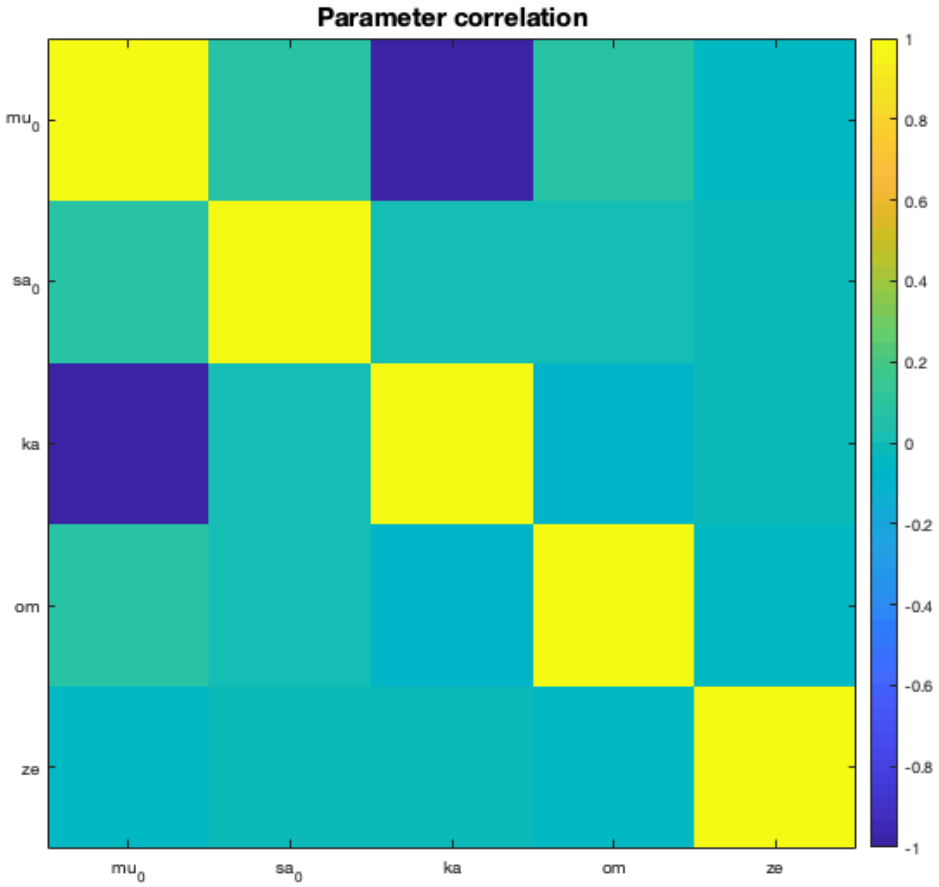
```
                    sim2.u,...
                    'tapas_hgf_binary_config_4',...
                    'tapas_unitsq_sgm_config',...
                    'tapas_quasinewton_optim_config')


%plot posterior correlation
tapas_fit_plotCorr(est3)

%plot trajectories
tapas_hgf_binary_plotTraj(est3)

%estimate model
est4 = tapas_fitModel(sim2.y,...
                    sim2.u,...
                    'tapas_hgf_binary_config_5',...
                    'tapas_unitsq_sgm_config',...
                    'tapas_quasinewton_optim_config')


%plot posterior correlation
tapas_fit_plotCorr(est4)

%plot trajectories
tapas_hgf_binary_plotTraj(est4)
```

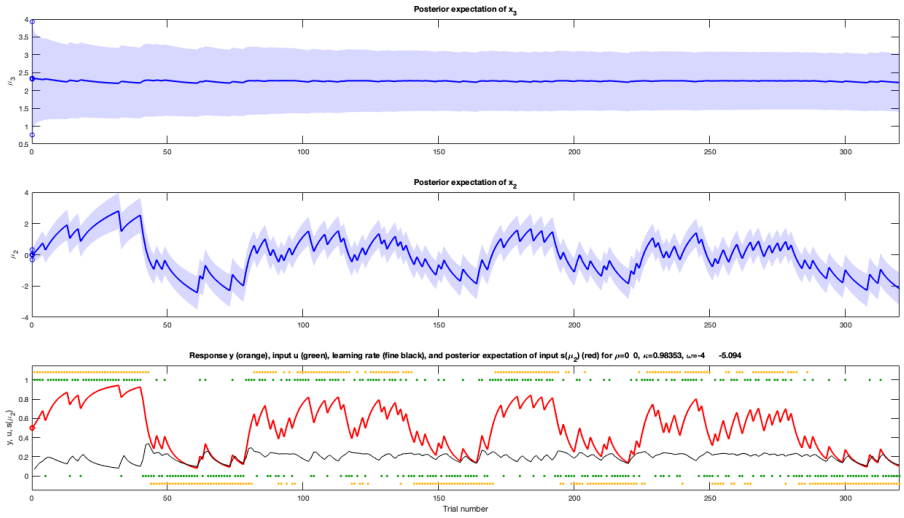
```
Ignored trials: none
Ignored trials: none
Irregular trials: none

Optimizing...

Calculating the log-model evidence (LME)...

Results:

Parameter estimates for the perceptual model:
    mu_0: [NaN 0 2.3358]
    sa_0: [NaN 0.1000 2.5182]
     rho: [NaN 0 0]
      ka: [1 0.9835]
      om: [NaN -4 -5.0940]


Parameter estimates for the observation model:
    ze: 5.7430

Model quality:
    LME (more is better): -59.8346
    AIC (less is better): 114.9848
    BIC (less is better): 133.8264

    AIC and BIC are approximations to -2*LME = 119.6692.
```

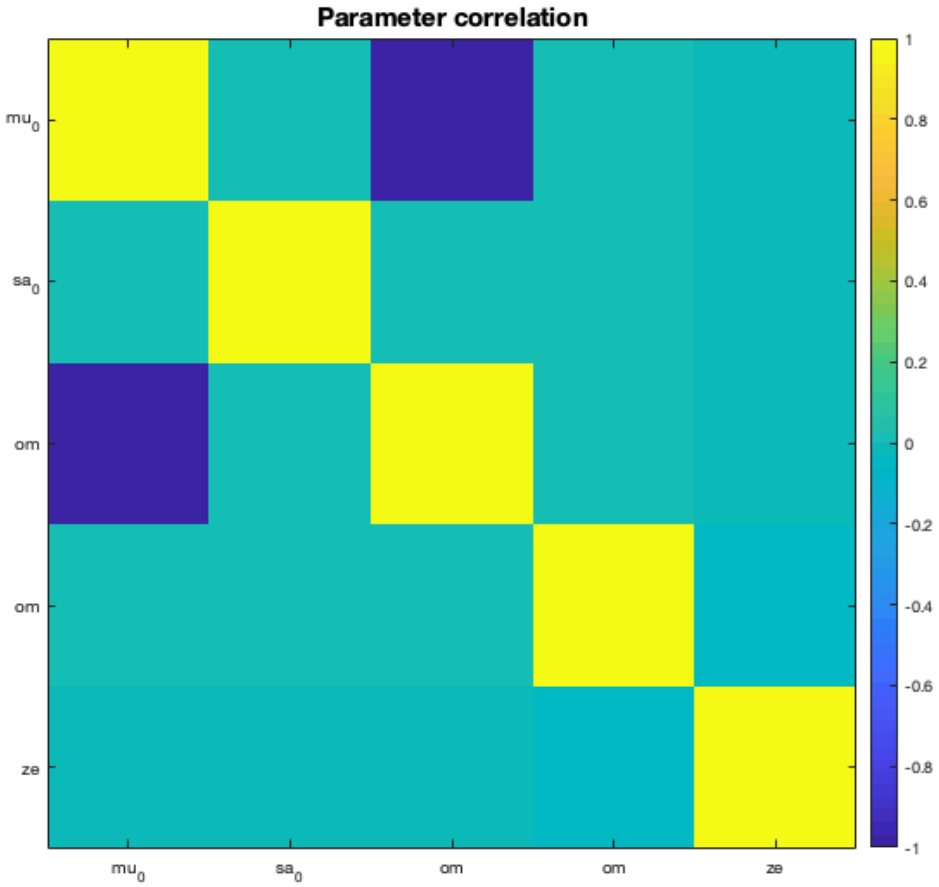
```
est3 =

  struct with fields:

        y: [320×1 double]
        u: [320×1 double]
      ign: []
      irr: [0×1 double]
    c_prc: [1×1 struct]
    c_obs: [1×1 struct]
    c_opt: [1×1 struct]
    optim: [1×1 struct]
    p_prc: [1×1 struct]
    p_obs: [1×1 struct]
     traj: [1×1 struct]

Ignored trials: none
Irregular trials: none

Optimizing...

Calculating the log-model evidence (LME)...

Results:

Parameter estimates for the perceptual model:
    mu_0: [NaN 0 2.4430]
    sa_0: [NaN 0.1000 2.5349]
     rho: [NaN 0 0]
      ka: [1 1]
      om: [NaN -4.1447 -5.1121]


Parameter estimates for the observation model:
    ze: 5.7433

Model quality:
    LME (more is better): -60.4467
    AIC (less is better): 114.9862
    BIC (less is better): 133.8278

    AIC and BIC are approximations to -2*LME = 120.8934.


est4 =

  struct with fields:

        y: [320×1 double]
        u: [320×1 double]
      ign: []
      irr: [0×1 double]
    c_prc: [1×1 struct]
```

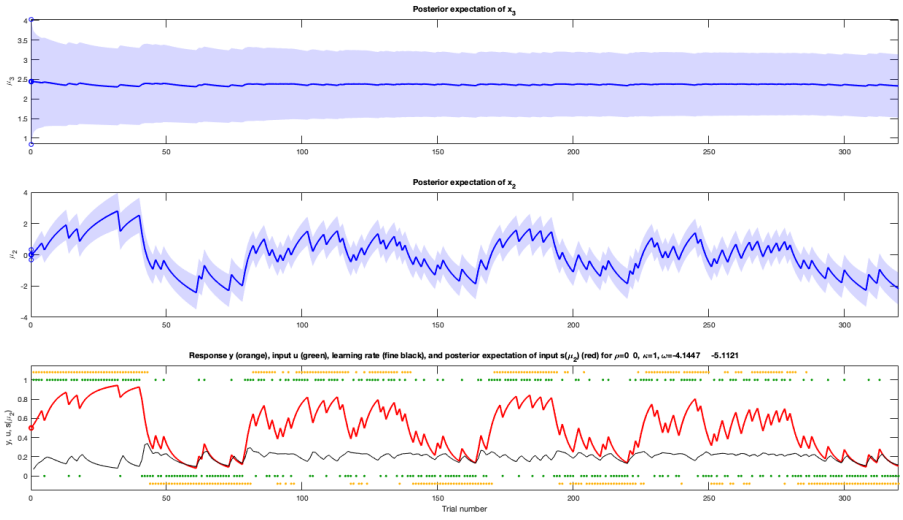
```
c_obs: [1×1 struct]
c_opt: [1×1 struct]
optim: [1×1 struct]
p_prc: [1×1 struct]
p_obs: [1×1 struct]
 traj: [1×1 struct]
```




Parameter correlation
mu0
sa0
ka
om
ze
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1


Posterior expectation of x3
Posterior expectation of x2
Response y (orange), input u (green), learning rate (fine black), and posterior expectation of input s(μ1) (red) for ϑ=0 0, κ=0.98353, ω=-4 -5.094
Trial number


Parameter correlation
mu0
sa0
om
om
ze
mu0
sa0
om
om
ze
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1


Posterior expectation of x3
Posterior expectation of x2
Response y (orange), input u (green), learning rate (fine black), and posterior expectation of input s(μ1) (red) for ϑ=0 0, κ=1, ω=-4.1447 -5.1121
Trial number

c)

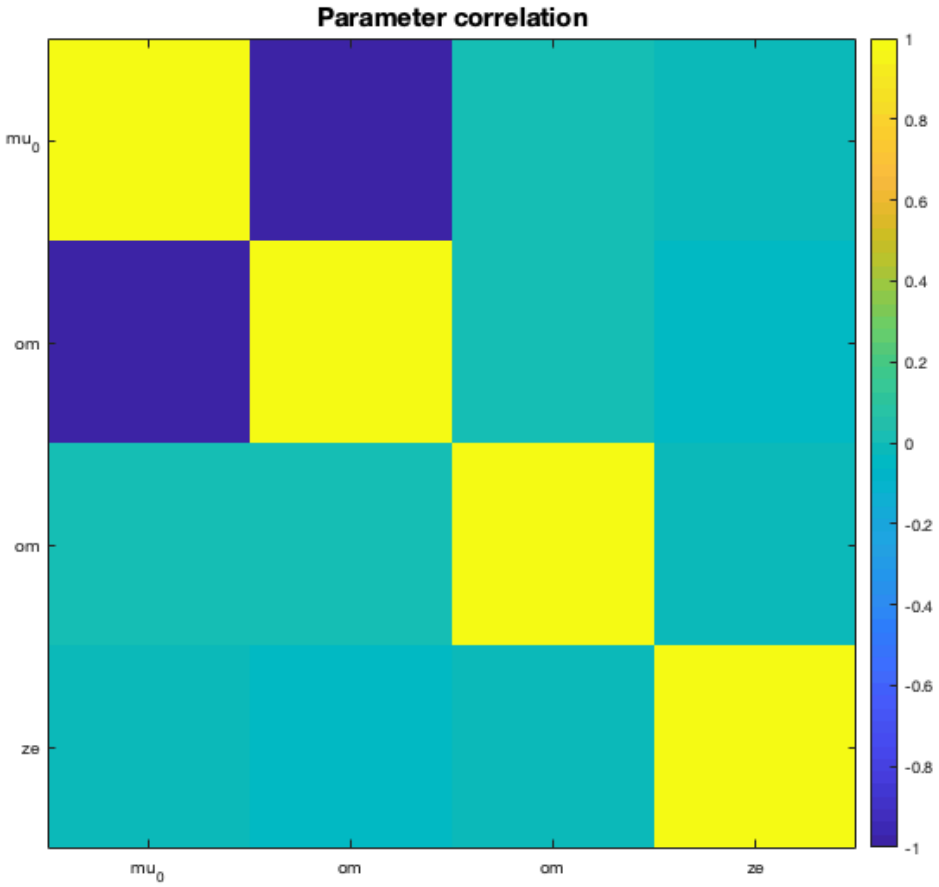
```
%The \mu_3 can only be changed without changing the other beliefs by
%changing \sigma_3 or \kappa_2.
```

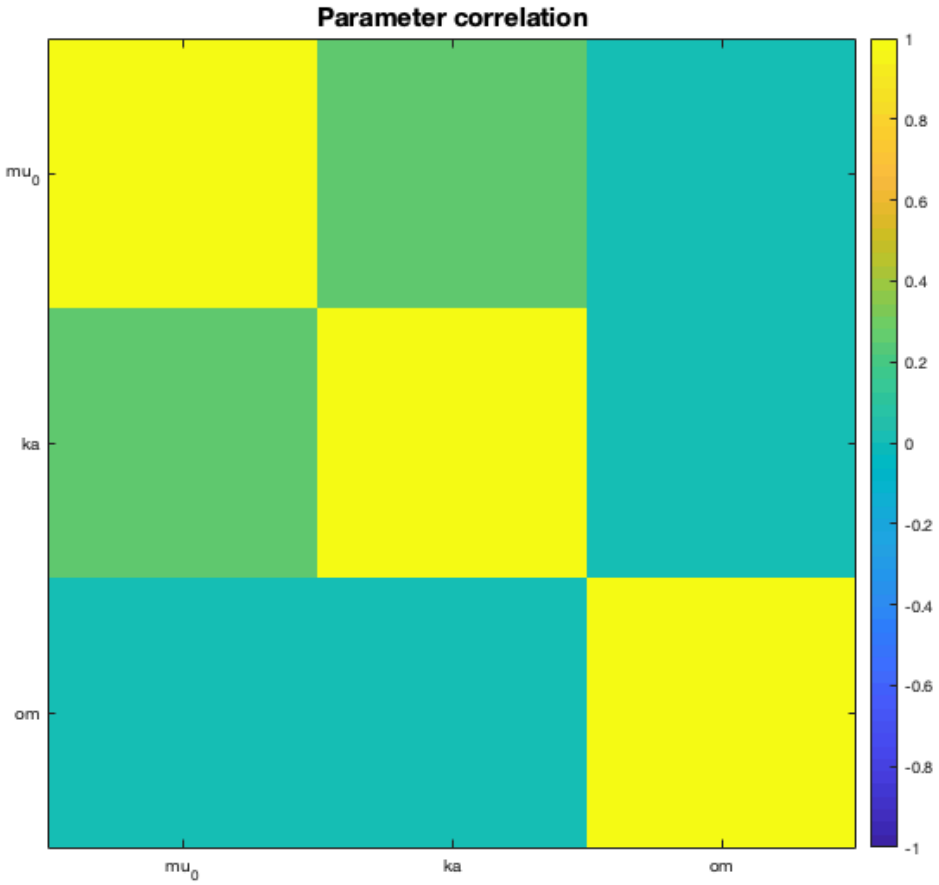
d) tapas_unitsq_sgm_mu3 as response model

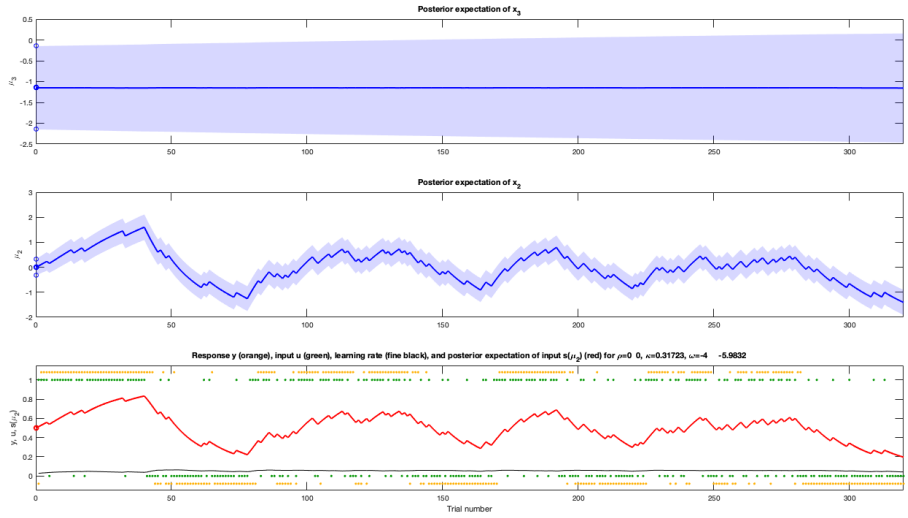
```
%Including a readout of $\mu _3$ in the response model, we now see
 much
%less correlation between the observed parameters than in a).
%The estimate for $\mu _3$ is -1.0342 while the actual value is 1.
%The estimate for $\kappa _2$ is much more accurate: it is 0.3246
 while the actual value is 1.
%The estimate for $\omega _2$ is for off the original value: the
 estimate
%is 0.0820 while the true value is -4.

%simulate model
sim = tapas_simModel(u,...
'tapas_hgf_binary',...
[NaN 0 1 NaN 1 1 NaN 0 0 1 2.5 NaN -4 -6],...
'tapas_unitsq_sgm',...
5);

%estimate param: (ze,mu3,K2,exp(w3))
est1 = tapas_fitModel(sim.y,...
                      sim.u,...
                      'tapas_hgf_binary_config_2',...
                      'tapas_unitsq_sgm_mu3_config',...
                      'tapas_quasinewton_optim_config')


%plot posterior correlation
tapas_fit_plotCorr(est1)

%plot trajectories
tapas_hgf_binary_plotTraj(est1)


%estimate param: (ze,mu3,w2,exp(w3))
est2 = tapas_fitModel(sim.y,...
                      sim.u,...
                      'tapas_hgf_binary_config_3',...
                      'tapas_unitsq_sgm_mu3_config',...
                      'tapas_quasinewton_optim_config')


%plot posterior correlation
tapas_fit_plotCorr(est2)

%plot trajectories
tapas_hgf_binary_plotTraj(est2)
```

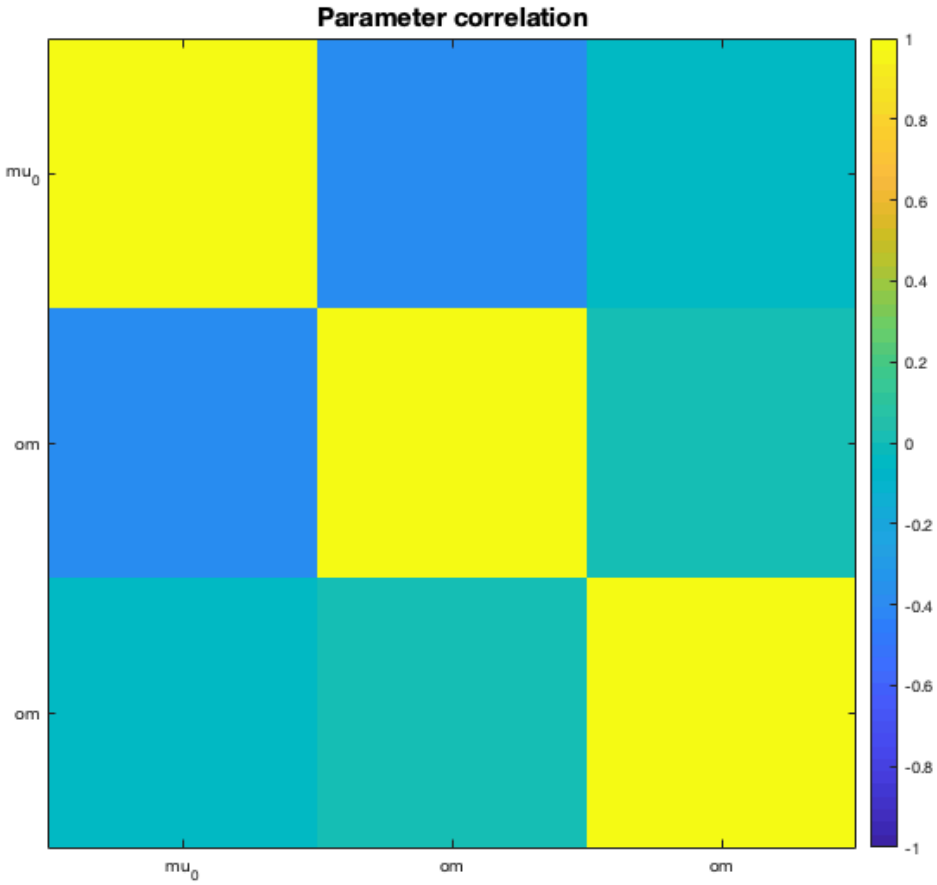
```
Ignored trials: none
Ignored trials: none
Irregular trials: none

Optimizing...

Calculating the log-model evidence (LME)...

Results:

Parameter estimates for the perceptual model:
    mu_0: [NaN 0 -1.1484]
    sa_0: [NaN 0.1000 1]
     rho: [NaN 0 0]
      ka: [1 0.3172]
      om: [NaN -4 -5.9832]

Model quality:
    LME (more is better): -146.211
    AIC (less is better): 275.8206
    BIC (less is better): 287.1256

    AIC and BIC are approximations to -2*LME = 292.4221.


est1 =

  struct with fields:

        y: [320×1 double]
        u: [320×1 double]
      ign: []
      irr: [0×1 double]
    c_prc: [1×1 struct]
    c_obs: [1×1 struct]
    c_opt: [1×1 struct]
    optim: [1×1 struct]
    p_prc: [1×1 struct]
    p_obs: [1×1 struct]
     traj: [1×1 struct]

Ignored trials: none
Irregular trials: none

Optimizing...

Calculating the log-model evidence (LME)...

Results:

Parameter estimates for the perceptual model:
    mu_0: [NaN 0 -1.4711]
    sa_0: [NaN 0.1000 1]
     rho: [NaN 0 0]
```

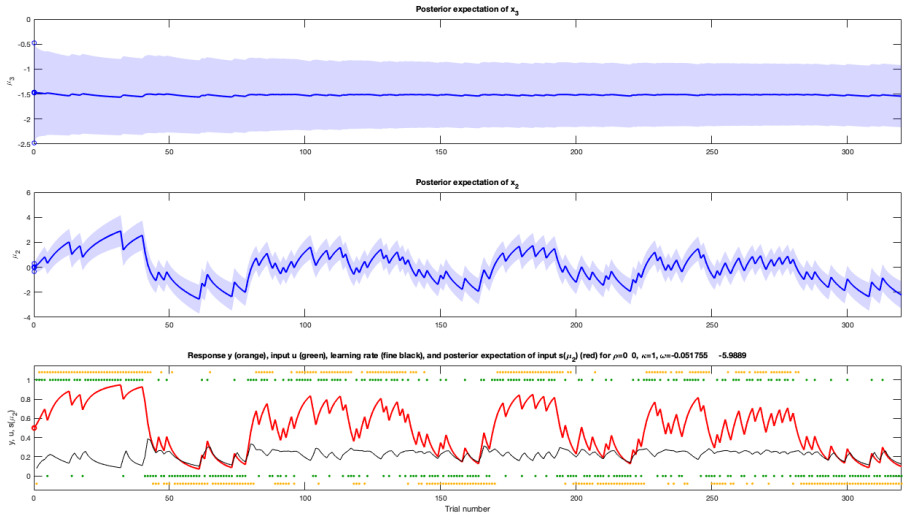
```
      ka: [1 1]
      om: [NaN -0.0518 -5.9889]

Model quality:
    LME (more is better): -67.1114
    AIC (less is better): 122.9276
    BIC (less is better): 134.2326

    AIC and BIC are approximations to -2*LME = 134.2227.


est2 =

  struct with fields:

        y: [320×1 double]
        u: [320×1 double]
      ign: []
      irr: [0×1 double]
    c_prc: [1×1 struct]
    c_obs: [1×1 struct]
    c_opt: [1×1 struct]
    optim: [1×1 struct]
    p_prc: [1×1 struct]
    p_obs: [1×1 struct]
     traj: [1×1 struct]
```


Parameter correlation
mu0
om
om
ze
mu0
om
om
ze
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1


Parameter correlation
mu0
ka
om
mu0
ka
om
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1


Posterior expectation of x3
Posterior expectation of x2
Response y (orange), input u (green), learning rate (fine black), and posterior expectation of input s(μ1) (red) for ϑ=0 0, κ=0.31723, ω=-4 -5.9832
Trial number


Parameter correlation
mu0
om
om
mu0
om
om
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1


Posterior expectation of x3
Posterior expectation of x2
Response y (orange), input u (green), learning rate (fine black), and posterior expectation of input s(μ2) (red) for ϑ=0 0, κ=1, ω=-0.051755 -5.9889
Trial number

```
close all
```

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